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(54) **FLUID DISPENSING DEVICE WITH METERED DELIVERY**

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B65D 35/46 (2006.01)

(52) **U.S. Cl.** **222/207**; 222/94; 222/335; 222/544

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See application file for complete search history.

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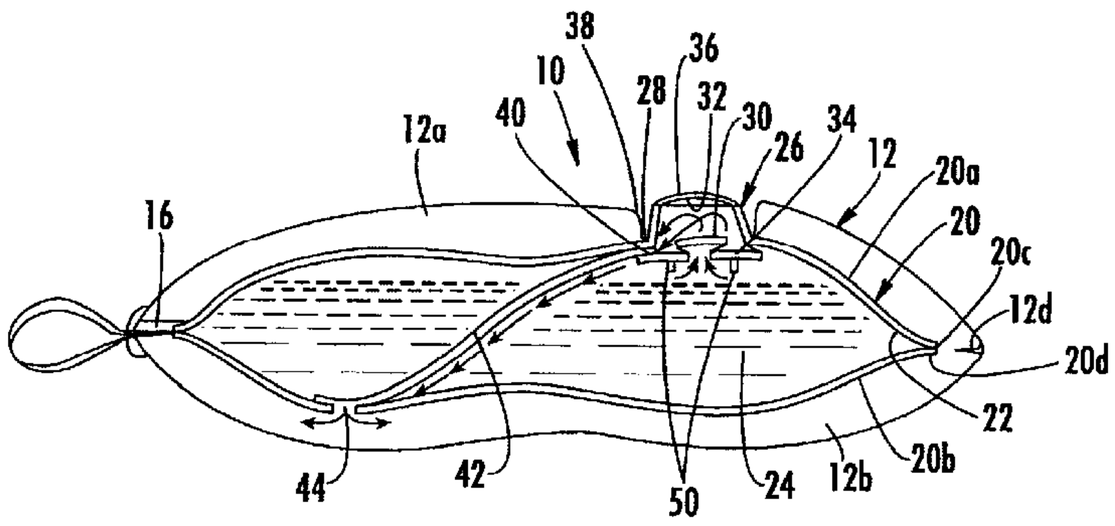
(57) **ABSTRACT**

A method of dispensing a fluid comprises providing a container made from flexible material and having an outer surface, a first opening and an interior fluid storage region therein. The method further comprises providing a volume of fluid within interior fluid storage region and providing a flexible metering housing, having a metering chamber therein with a predetermined volume, disposed in fluid communication with interior fluid storage region. The method further comprises providing an intake valve disposed between container and flexible metering housing permitting unidirectional fluid flow from interior fluid storage region into metering chamber. The method further comprises providing an exit port in fluid communication with container with an output valve disposed between exit port and metering chamber, depressing and releasing flexible metering housing, and filling the metering chamber with a volume of fluid by vacuum force in an amount by the volume of the metering chamber.

21 Claims, 5 Drawing Sheets



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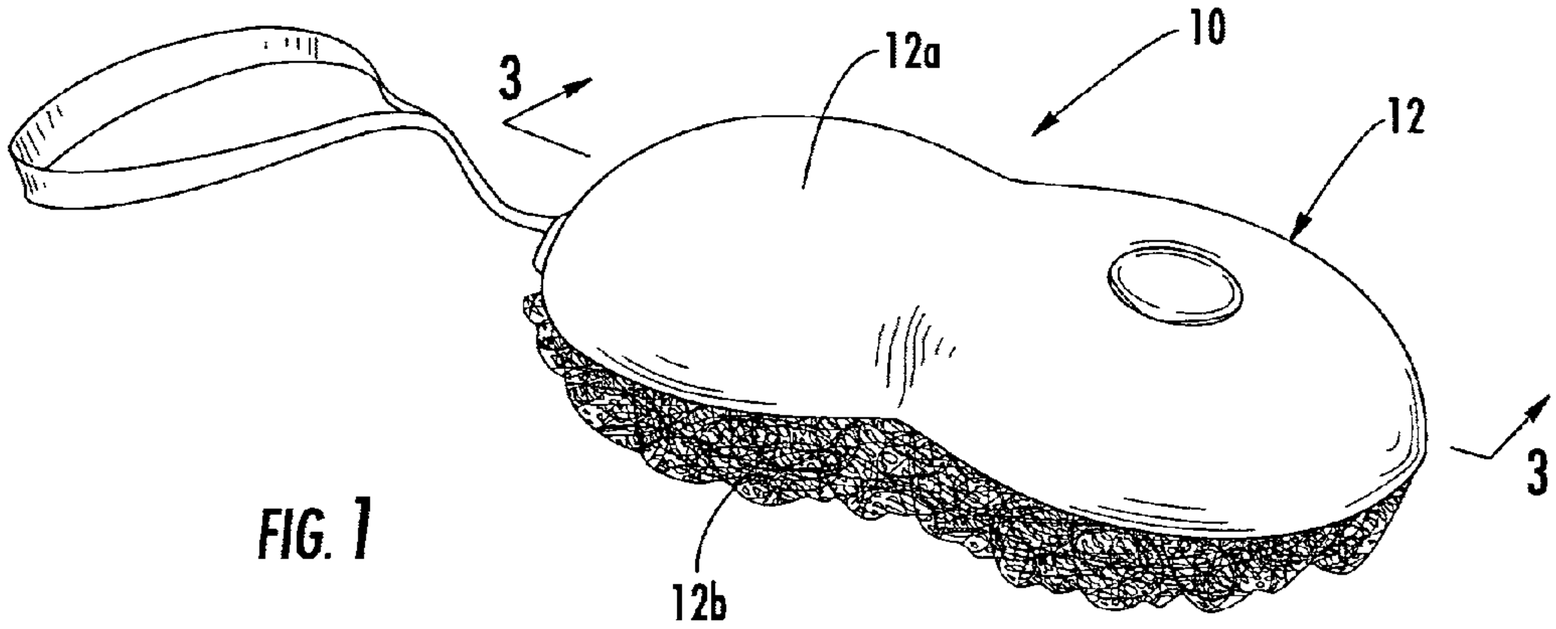


FIG. 1

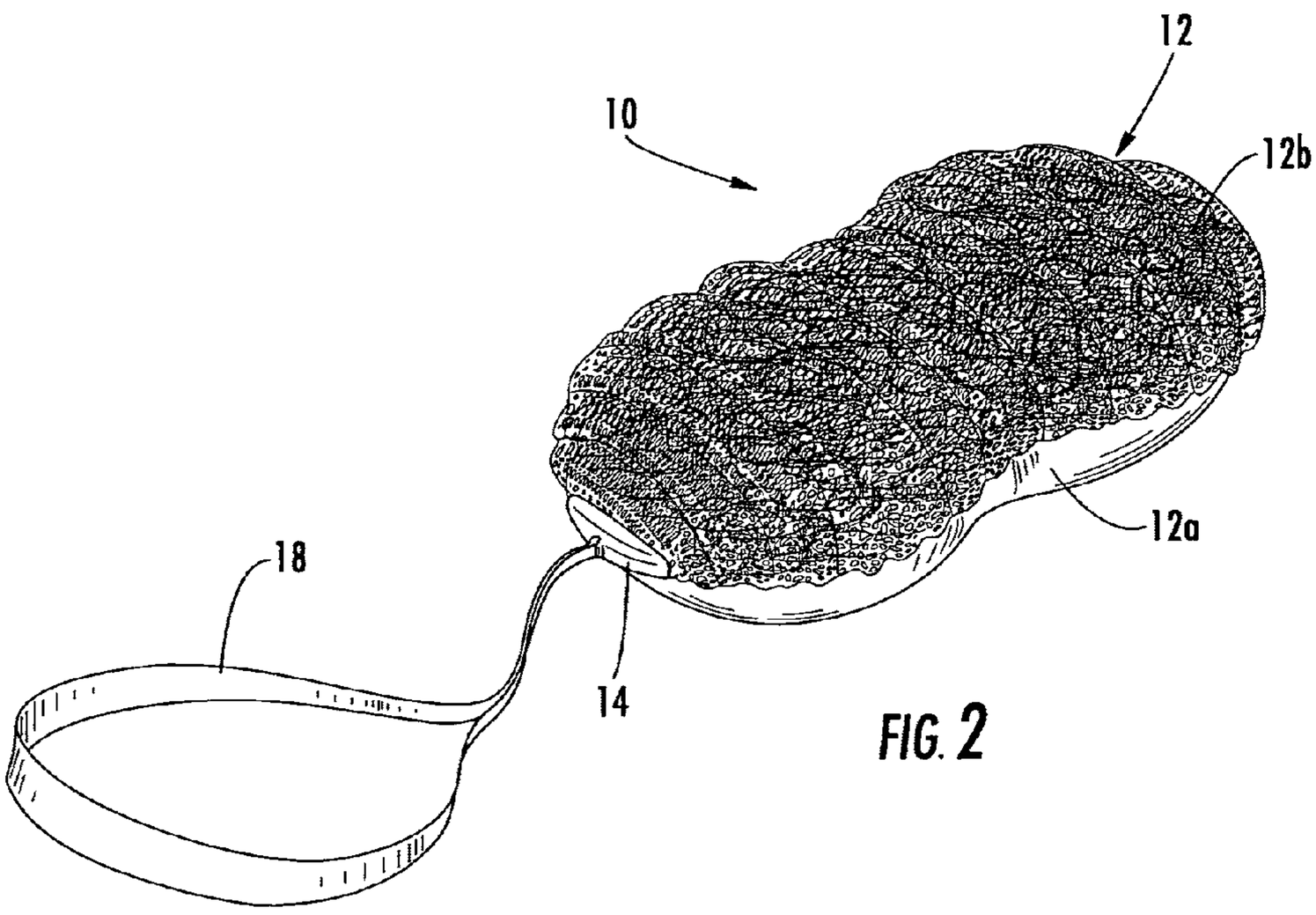
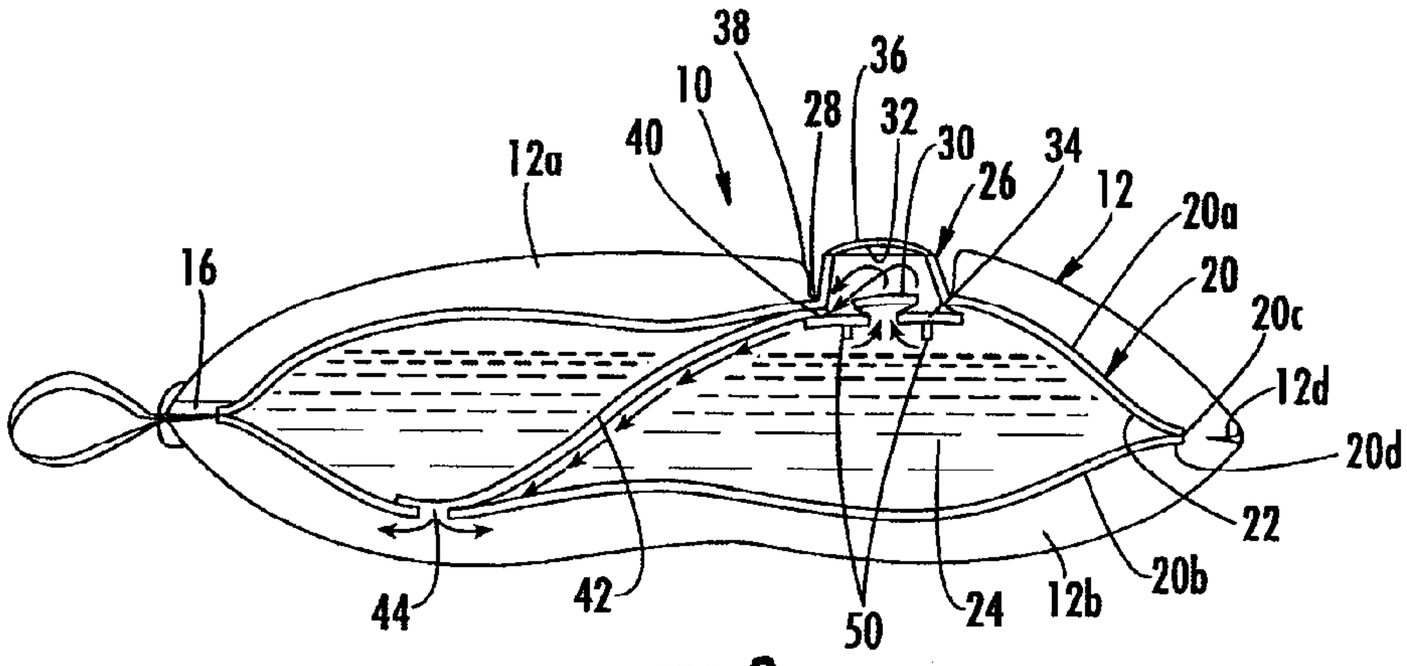


FIG. 2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36
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28
32
40
30
34
26
12a
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20a
16
20
20c
12d
20d
22
20b
12b
24
50
42
44

FIG. 3

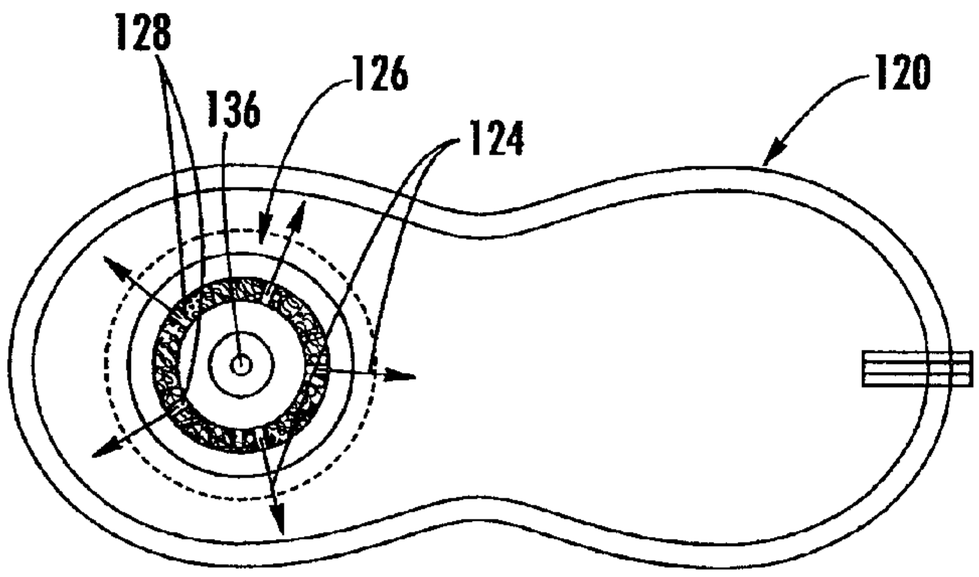
128
126
120
136
124

FIG. 4

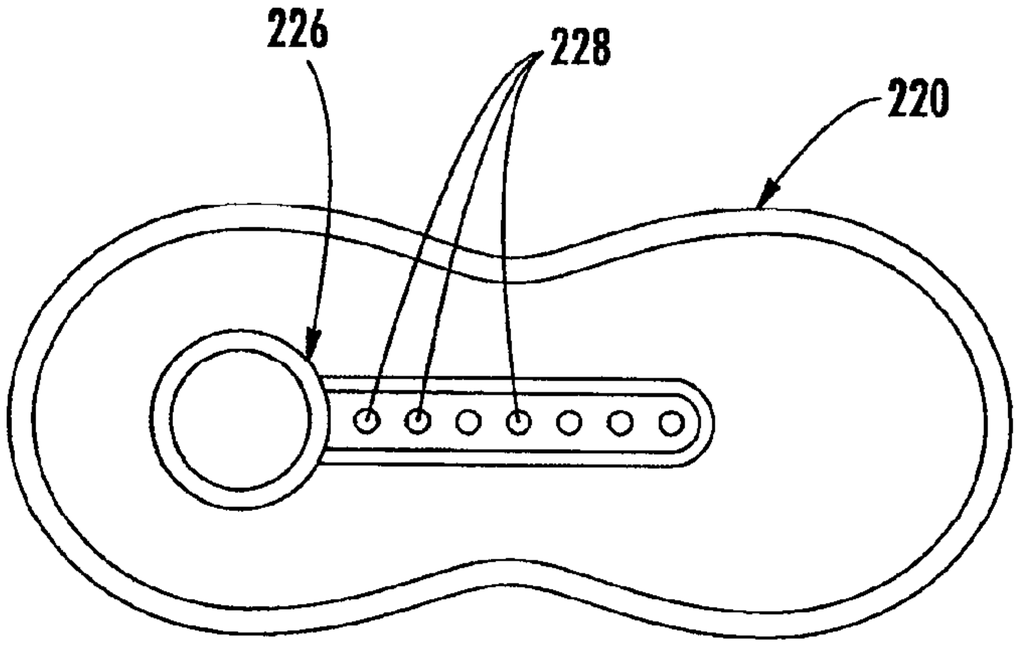

FIG. 5

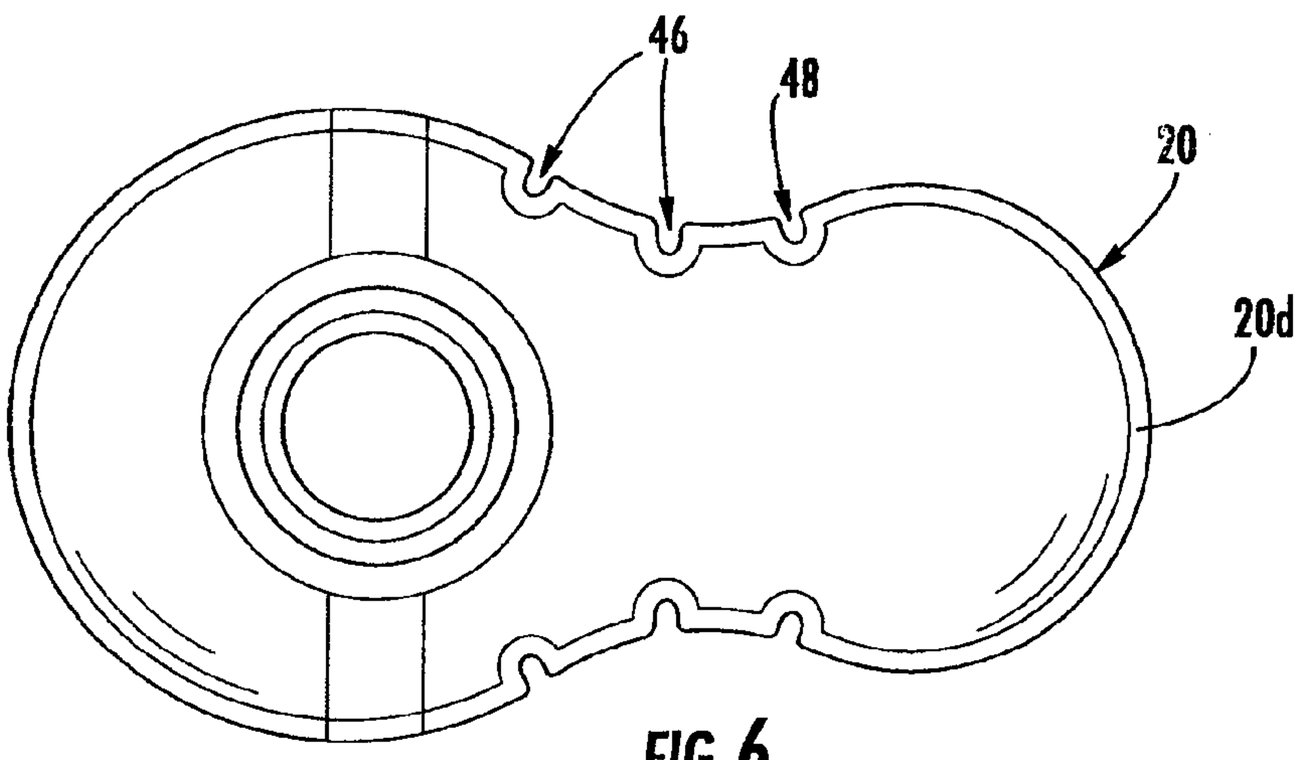

FIG. 6

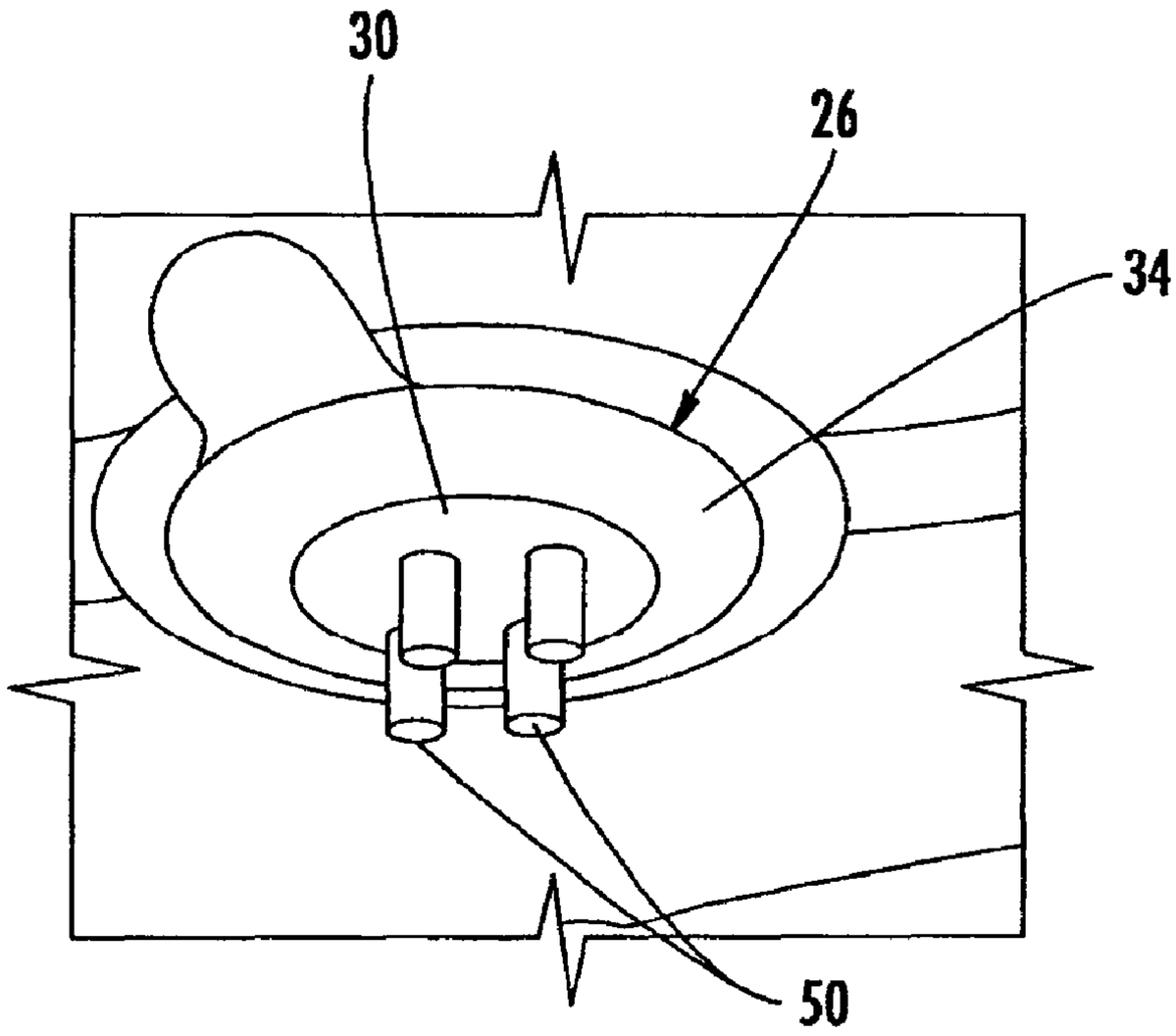

FIG. 7

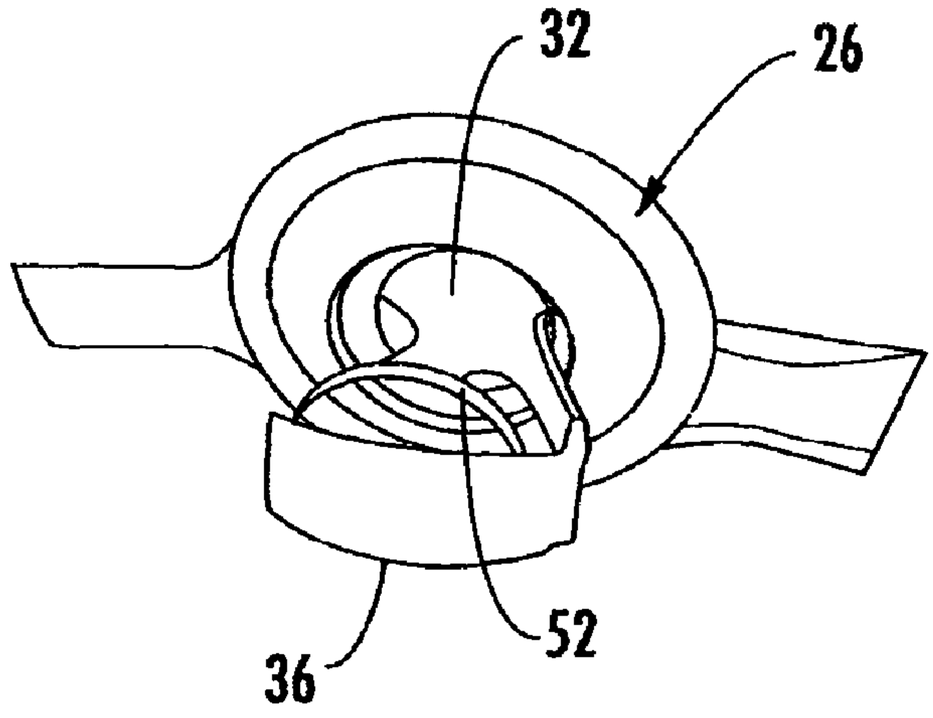

FIG. 8

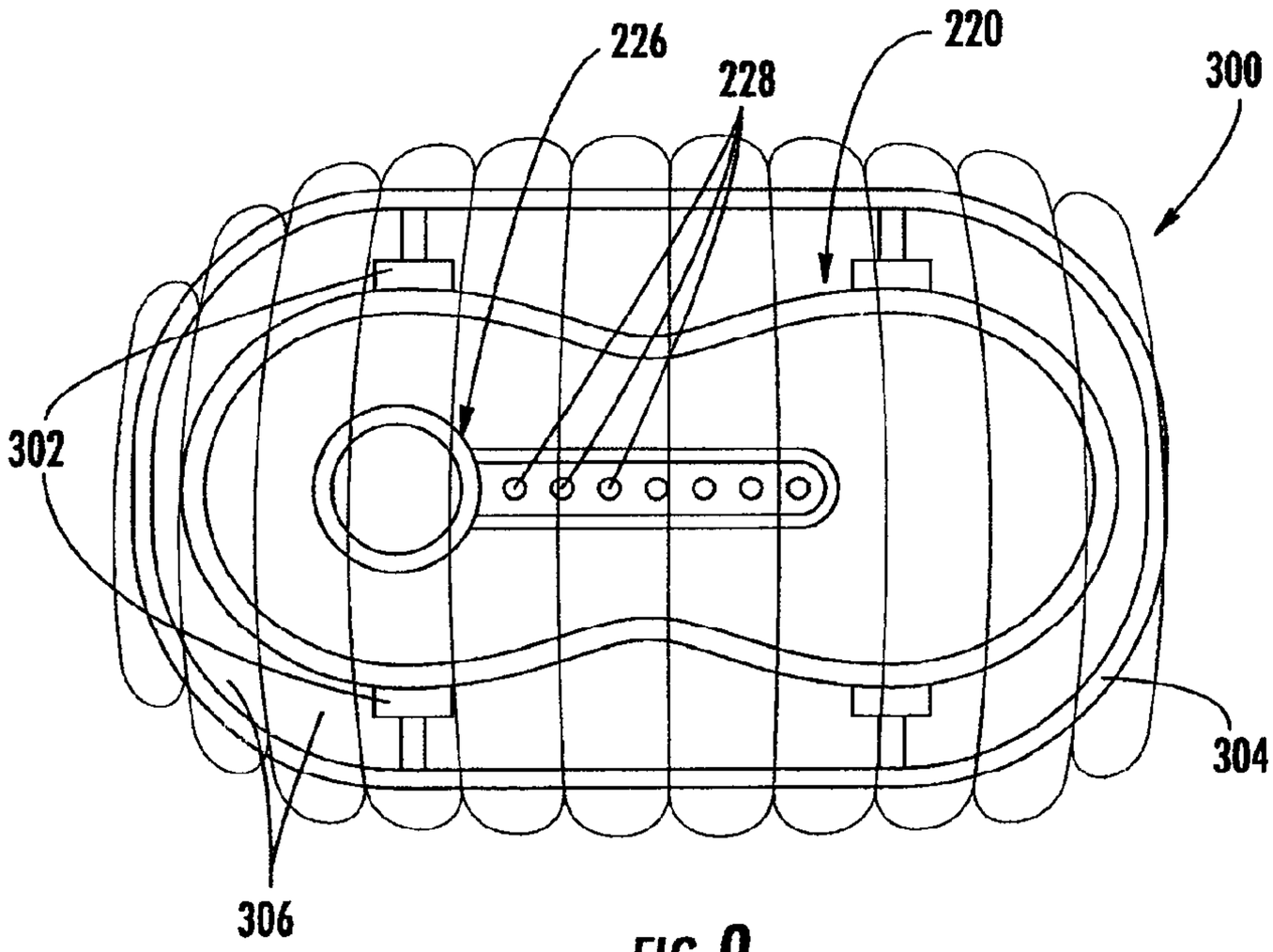

FIG. 9

FLUID DISPENSING DEVICE WITH METERED DELIVERY

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 11/946,066 filed Nov. 28, 2007, which is a divisional of U.S. patent application Ser. No. 11/074,817, filed on Mar. 8, 2005, now U.S. Pat. No. 7,419,322 issued on Sep. 2, 2008, which in turn claims the benefit under 35 U.S.C. §119(e) of the U.S. Provisional Patent Application Ser. No. 60/551,993, filed on Mar. 10, 2004. All prior applications are herein incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

This invention relates generally to dispensing devices and packages. More specifically, the present invention relates to metering devices that can controllably dispense fluid media from a source of fluid media.

Various types of fluid material and media are employed for different purposes through commerce and industry. For example, there are various products in the personal care, home care, air care, transportation care, and food industries that require some type of dispensing of a fluid material from a source of such material. When this material is sold in commerce, it must be contained and stored in some type of container. When that product is used, it must be dispensed from its storage container to a location for use.

In the prior art, there are many different types of dispenses for delivering fluid material. For example, a flexible container body with a nozzle tip is commonly provided for such a purpose. An application of such use is for the dispensing of ketchup where the container body is squeezed by the user to urge the fluid material out from the nozzle tip and accurately to a desired location. The amount of fluid delivered is determined by the how much the user squeezed the container body. However, this yields erratic results where more or less fluid material is delivered on each successive squeeze of the container body. Also, the container must be held upright to avoid leakage because no valves are employed.

In another example of a prior art dispensing device, a flexible container holds a volume of fluid material to be delivered. A single one-way check valve is provided as an exit port from the flexible container. When the flexible body is squeezed, the material is urged out under pressure through the valve.

There has also been a desire to not only dispense the fluid material but also to help apply them, such as to a surface. In the prior art, the squeezable container bodies have been equipped with some type of applicator head for this purposes. For example, in the personal care industry, body wash devices commonly include some type of squeezable container body and an abrasive applicator material, such as fabric or foam, applied thereon. Thus, when the fluid material is present outside the container body, the applicator assists in spreading the material on the body of the user by spreading the fluid within the applicator for better and more even distribution thereof. Applicators are particularly useful for even distribution in personal care industry, such as shoe polish, to ensure a quality even and smooth coat.

There have been attempts in the prior art to provide a dispenser that can easily deliver fluid material to an applicator positioned about a container body. These prior art devices employ, for example, spring-loaded buttons that open up an exit port in the main container body to permit flow to an outer applicator material layer. This is in contrast to requiring the user to squeeze the entire body of the container. However, these devices are incapable of delivering a substantially equal dose of fluid at each dispensing operation because they simply open up the container body and permit the fluid to flow to the applicator material by gravity. As a result, the fluid material must exit at a lower side of the container. Therefore, it is not possible to dispense fluid on more than one side of the container or in a direction opposite to that of gravity. To dispense fluid material without concern for gravity, squeezable container bodies must be employed in the prior art which have all of the disadvantages, as described above.

In view of the foregoing, the fluid dispensing and devices of the prior art suffer from various disadvantages that make them difficult and awkward to use with unexpected results. Therefore, there is a need for a fluid dispenser to be easy to operate. There is a further need for a fluid dispenser to be capable of delivering a metered dose of fluid upon each dispensing operation for expected flow for better application of the fluid material. There is also a need for such a dispenser to be gravity independent. There is an additional need for the fluid to be capable of being delivered to exit at any point on the surface of container. There is a further need for a dispenser to include an applicator material for even distribution and even application of the fluid material, as desired.

SUMMARY OF THE INVENTION

The present invention preserves the advantages of prior art dispensing devices. In addition, it provides new advantages not found in currently available devices and overcomes many disadvantages of such currently available devices.

The invention is generally directed to a novel and unique dispenser for delivering a substantially equal metered dose of fluid material upon each dispensing operation with an optional applicator for even distribution of the dispensed fluid material.

The fluid dispensing device includes a container with an interior fluid storage region therein. A flexible metering housing is disposed in fluid communication with the fluid storage region a first one-way valve disposed between the container and the flexible metering housing. One way flow from the interior fluid storage region of the container fills the predetermined volume of the metering chamber with fluid by vacuum action when the flexible metering housing is depressed and then released. A second valve is in fluid communication with the metering housing output port and permits one-way fluid flow from the metering chamber to the exterior outer region of the container when the metering housing is depressed again. Each time the metering housing is depressed a substantially equal volume of fluid is dispensed from the container. An additional foam layer on the outside of container facilitates dispersion and delivery of the fluid.

It is therefore an object of the present invention to provide a fluid dispensing device that can deliver a substantially equal volume of fluid material from each dispensing operation.

It is an object of the present invention to provide a fluid dispensing device that is insensitive to gravity.

It is a further object of the present invention to provide a fluid dispensing device that includes an applicator to ensure even delivery of the fluid material.

Another object of the present invention is to provide a fluid dispensing device that can deliver fluid flow at any point from the device.

It is a further object of the present invention to provide a fluid dispensing device that can deliver fluid flow at multiple locations from the device.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features which are characteristic of the present invention are set forth in the appended claims. However, the invention's preferred embodiments, together with further objects and attendant advantages, will be best understood by reference to the following detailed description taken in connection with the accompanying drawings in which:

FIG. **1** is a top perspective view of the dispensing device of the present invention;

FIG. **2** is a bottom perspective view of the dispensing device of the present invention;

FIG. **3** is a cross-sectional view through the line **3-3** of FIG. **1**;

FIG. **4** is a top plan view of a first alternative embodiment of the present invention;

FIG. **5** is a top plan view of a second alternative embodiment of the present invention;

FIG. **6** is a top plan view of the dispensing device of the present invention showing flow enhancing notches;

FIG. **7** is a close-up perspective view of the metering housing with stand-off legs;

FIG. **8** is a close-up perspective view of the metering housing with coil spring; and

FIG. **9** is a top plan view on an alternative embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring first to FIGS. **1** and **2**, the dispensing device **10** of the present invention is shown to include an outer covering, generally referred to as **12** which serves as an applicator material. This applicator material **12** can be formed of any type of material to suit the application at hand. For example, as seen in FIGS. **1** and **2**, the cover **12** is preferably formed of two different types of material **12***a*, **12***b* to serve two purposes when in use. Preferably, the top section **12***a* is of a foam material while the bottom section **12***b* is of a mesh or "pouf" material. The top section **12***a* can be secured to the bottom section **12***b* by, for example, welding. A snap-fit cover **14** seals a re-fill port **16**, as will be described in more detail in connection with FIG. **3**. A hang strap or cord **18** can also be provided. The configuration of the applicator **12** is just one of many different types of applications of the present invention which will be discussed in more detail below.

Turning now to FIG. **3**, a cross-sectional view through the line **3-3** of FIG. **1** is shown to illustrate the internal construction of the dispensing device **10** of the present invention. A container body **20** is provided which includes a fluid storage region **22** that contains a volume of fluid material **24** therein. The container **20** is preferably made of a flexible material, such as plastic or nylon. Thus, as fluid material **24** is evacuated from within the container body **20**, it will collapses gradually for a compact structure.

A metering housing **26** is provided at a first opening **28** of the container body **20**. The metering housing **26** includes an intake one-way valve **30**, such as a check valve, to pull fluid **24** from the fluid storage region **22** of the container body **20** into a metering chamber **32** of a predetermined size. Any type of valve can be used to suit the given application. The intake valve **30** is positioned in a base plate **34** of the metering housing **26**. Thus, fluid **24** can only flow in one way from the fluid storage region **22** into the metering chamber **32**. The metering chamber **32** is defined by a flexible membrane **36** in the form of a button or bulb which is accessible and manipulateable through a gap **38** in the applicator material **12**. The button **36** is preferably clear to provide an indicator to the consumer when the metered dosage of fluid material **24** is ready for delivery.

An output valve **40** is provided in fluid communication with the metering chamber **32** of the metering housing **26**. Thus, the fluid residing in the metering chamber can only exit through the output valve **40**. Also, a fluid conduit **42** is also provided to direct the exit of fluid **24** at any location through the container body. Preferably, as seen in FIG. **3**, the fluid conduit **42** connects the output valve **40** of the metering housing **26** to an exit port **44** located on the bottom of the container body. This permits the metering housing **26** to be on an opposite side as the side through which the fluid **24** exits. The fluid conduit **42** can be directed and located to exit at any point through the container body **20** depending on the application at hand. Also, the output valve **40** may be located at the exit port **44**, as an alternative depending on the requirements of the application.

Still referring to FIG. **3**, the operation of the dispensing device **10** is further explained. The button **36** of the metering housing **26** is depressed to initiate a vacuum operation. More specifically, when the button **36** is further released, fluid **24** is pulled from the fluid storage region **22** of the container body **20** into the metering chamber **32** which is configured to be of a certain known volume. The act of releasing the button **36** fills the metering chamber **32** to substantial capacity. Thus, a metered amount of fluid material **24** is contained within the metering chamber **32** in preparation for delivery. The size of the metering chamber **32** can be selected according to the type of fluid material **24** to be dispensed and the application therefor and the desired dosage volume.

A further depression of the button **36** urges the measured volume of fluid **24** within the metering chamber **32** to be exiting out through the output valve **40** of the metering housing **26**. This known amount of fluid material **24** is then either directly routed to the applicator **12** for use or through a fluid conduit **42**, as seen in FIG. **3**, for more targeted introduction into the applicator **12**. In this case, it is preferred that the metered volume of fluid material **24** be routed to the bottom of the container body **20** for dispersion into the applicator portion **12***b* on the bottom surface thereof. For example, this configuration is particularly well-suited for dispensing body wash for bathing purposes. Other applications may require different exit and introduction locations into the applicator material **12**.

In FIG. **4** an alternative construction of the container **120** with modified metering housing **126** is shown. In this embodiment, an array of output valves **128** is positioned radially about the periphery of the metering housing **126** to deliver fluid material **124** directly to the applicator material (not shown in FIG. **4** for ease of explanation) on the same side thereof without employing a fluid conduit **42** that is routed through the interior of the container body **20**. This radial delivery pattern is well-suited for use in application devices requiring simultaneous dispersion of contents around the metering housing, such as for applying skin conditioner.

Still further, FIG. **5** illustrates another alternative construction of a container **220** with modified metering housing **226** of the present invention where an array of output valves **228** is positioned linearly across the top surface of the container body **220** to deliver fluid material directly to the applicator material (not shown in FIG. **5** for ease of explanation) on the same side thereof without employing a fluid conduit. This linear delivery pattern is well-suited for use as an applicator

that applies fluid in a linear stroke-based manner along the longitudinal axis of the device.

In accordance with the present invention, the direction of the delivery of the fluid material **24** can be easily modify to suit the application at hand. In certain applications, it is desirable that the applicator material **12**, located on the top and the bottom of the container body **20**, receive fluid material in an evenly distributed fashion. As shown above, the fluid material **24** can be directed out from any location on the container **20** to deliver the fluid as desired. It is frequently desirable that the fluid **24** be able to passively flow from one side **20***a* of the container **20** to the opposing side **20***b* of the container **20**, particularly at the edges **20***c* thereof.

Referring back to FIG. **1**, an efficient method of manufacturing a quality dispensing device **10** is to employ heat welding to construct the container **20** and the applicator material **12** thereon. For example, a top portion **20***a* is typically heat welded to a bottom portion **20***b* about their periphery **20***c* to form a container **20** with an interior fluid storage region **22** therein. The applicator material **12** is similarly secured to the container **20** by heat welding or other similar process, such as gluing, either about its periphery or its entire contact surface with the container **20**.

If a heat welding seam **20***d* about the periphery **20***c* of the container **20** is employed, it will reduce the flow and wicking action of the fluid **24** in the applicator material **12***a* on one side to the applicator material **12***b* on the other side and vice versa. Thus, fluid **24** must travel over the seam **20***d* of the container and seam **12***d* of the applicator material **12** to be present on the opposing side. This seam **12***d*, **20***d* prevents the fluid **24** from freely flowing from the front of the container **20** to the back and vice versa.

FIG. **6** illustrates a modification to the container **20** which is within the scope of the present invention to address the problem indicated above. More specifically, a number of notches **46** are formed in the peripheral edge **20***d* of the container **20** to permit flow of fluid material **24** easily from one side of the container **20** to the other. When the applicator material **12** is heat sealed to the container at its peripheral edge to form a seam **12***d*, a number of pass-through apertures **48** are formed between the seam **20***d*, **12***d* and the applicator material **12** to permit free flowing travel of fluid material **24** from one side of the device **10** to the other and back without having to travel over the peripheral seam **12***d*, **20***d*.

Turning now to FIGS. **3**, **7** and **8**, further enhancements to the metering housing **26** construction are shown in detail. As seen in FIGS. **3** and **7**, a number of stand-off legs **50** emanate downwardly from the base plate **34** of the metering housing **26**. These legs **50** prevent the base plate **34** from completely bottoming out and block flow of fluid material **24** into the intake valve **30**. The stand-off legs **50** are particularly useful when the volume of fluid material **24** left in the container **20** is running low and the container **20** is becoming relative flat in configuration. In this situation, there is a possibility that the aforesaid bottoming out may occur. However, the use of the stand-off legs **50** of FIGS. **3** and **7** prevent this from occurring.

FIG. **8**, with reference back to FIG. **3**, illustrates a further modification of the metering housing **26** to ensure that maximum suction is achieved and that the entire metering chamber **32** is filled upon each depression and release of the button **36**. A spring-biasing structure **52** resides within the button or bulb structure **36** of the metering housing **26**. Thus, the button **36** recovers quickly while providing a strong suction or vacuum to fill the interior of the metering chamber **32** with the desired metered volume of fluid material **24**. A coil spring is preferred for the spring-biasing structure **52** but other spring-biasing structures, such as leaf springs and foam material may be employed for this purpose.

FIG. **9** illustrates a further alternative embodiment **300** of the present invention where a container, such as container **220** or **120**, includes a series of tabs **302** that emanate outwardly from the container **220**. An outer frame or skeleton **304** is connected to the container **220** via the tabs **302**. Applicator material **306**, such as "poof" or fabric material, is then attached to the frame **304** with the container **220** residing therein. This embodiment **300** is particularly well-suited to permit free flowing of fluid material about the dispenser **300**.

The dispensing device **10** of the present invention has a wide array of applications of use to take advantage of the unique metered dosage capability of the present invention. Virtually any dispenser with any type of applicator material or combinations of applicator materials in different configurations can employ the present invention.

For example, the personal care industry has particular application in the controlled and metered dispensing of bath and shower gels. Also, medicines, cosmetics, hair care products, such a shampoos, skin care products, such as lotions, insect repellents and sunscreen products can employ the present invention.

Also, various home products can be delivered in a device **10** according to the present invention. These include products for furniture cleaning and polishing, tub and shower cleaning, floor cleaning and polishing, window cleaning, odor elimination, oven cleaning, laundry cleaning and apparel treatment. Also, air treatment device can employ the present invention.

Still further, cleaning products can be dispensed in a controlled fashion, such as those for cleaning cars, bikes, planes and trucks. The food industry has numerous potentional applications, particularly for the dispensing of condiments, sauces and vitamins.

To employ the dispensing device **10** of the present invention, the size and construction of the metering housing **26** as well as the positioning of where the fluid material **24** is delivered to the surface of the device can be easily modified to suit the given application. The materials used for the container **20** and the metering housing **26**, while preferably flexible plastic, can be any suitable material for the application at hand. Also, the container **20** can be made of a different material than the metering housing **26**.

Most importantly, the modification of the present invention to suit a given application relates particularly to the nature and configuration of the applicator material **12** itself.

The applicator material **12** can be foam, such as open cell foam, fabric, blended material, co-extruded material and combinations thereof. It should be understood that these materials are just examples of the types of materials that can be used in connection with the dispenser **10** of the present invention. The specific material is determined by the given application and the type of material to be dispensed.

Thus, when fluid material **24** is dispensed within the foam, the fluid **24** will tend to equilibrate the moisture by moving the moisture from a point of high moisture to a point of low moisture. This wicking action causes the fluid **24** to naturally propagate through the applicator material **12**. Since there is an absence of applicator material **12** at the periphery, the notches **46** and pass-through apertures **48** of FIG. **6**, facilitates the wicking action from one side of the device **10** to the other, if necessary in that application.

Non-woven materials or fibers may also be employed as the material for the applicator **12** on one or both sides of the device. For example, reticulated foam may also be employed.

These materials would be well-suited as applicators **12** for more harsh chemicals, such as tire cleaner and paint remover where toughness is required.

Also, more abrasive material can be provided on one side of the device for more aggressive cleaning, for example, while the opposing side has a polishing type surface.

In general, the size, density and wicking action of the cells and overall size of the applicator **12** can be modified to suit the particular fluid to be applied.

In summary, a new and novel dispenser **10** is provided that can deliver consistent metered dosages such fluid material **24**. The dispenser **10** has a greatly improved construction where the fluid material **24** is even distributed throughout the applicator material **12** for a more efficient and more effective fluid dispensing.

It would be appreciated by those skilled in the art that various changes and modifications can be made to the illustrated embodiments without departing from the spirit of the present invention. All such modifications and changes are intended to be covered by the appended claims.

What is claimed is:

1. A fluid dispensing device, comprising:

a collapsible container having an outer surface and a first opening therethrough, the collapsible container defining an interior fluid storage region therein, and an exterior outer region;

a flexible metering housing defined by a flexible membrane, the flexible membrane protruding through the first opening in the outer surface of said collapsible container so as to be exposed to the exterior outer region, said flexible metering housing having a metering chamber therein with a predetermined volume, disposed in fluid communication with the fluid storage region, an intake valve disposed between the collapsible container and the flexible metering housing and permitting unidirectional fluid flow from the interior fluid storage region of the collapsible container into the metering chamber thereby filling the predetermined volume of the metering chamber regardless of the collapsible container's orientation with respect to gravity;

an output valve, in fluid communication with the metering housing and permitting unidirectional fluid flow from the metering chamber to the exterior outer region of the collapsible container of a volume of fluid substantially equal to the predetermined volume of the flexible metering housing; and

wherein the collapsible container is made from a flexible material, and wherein the flexible material of the collapsible container and the unidirectional flow of the intake valve cause the collapsible container to collapse as fluid is evacuated from within the collapsible container such that the fluid dispensing device dispenses fluid regardless of the collapsible container's orientation with respect to gravity.

2. The fluid dispensing device of claim **1**, further comprising:

a fluid conduit having a first end and a second end, the fluid conduit connected at the first end to the output valve and at the second end to an exit port defined by the collapsible container.

3. The fluid dispensing device of claim **1**, further comprising:

a fluid conduit disposed between the metering housing and the output valve.

4. The fluid dispensing device of claim **3**, wherein the fluid conduit is routed through the interior fluid storage region of the collapsible container.

5. The fluid dispensing device of claim **1**, wherein the intake valve and the output valve are one-way check valves.

6. The fluid dispensing device of claim **1** wherein said flexible metering housing is further defined by a base plate in which the intake valve and the output valve are formed.

7. The fluid dispensing device of claim **1**, further comprising:

at least one standoff connected to the metering housing and proximal to the intake valve to prevent the intake valve from being blocked.

8. The fluid dispensing device of claim **7**, wherein the standoff is at least one leg.

9. The fluid dispensing device of claim **7**, wherein the standoff is a spring.

10. The fluid dispensing device of claim **1**, wherein the flexible membrane of said flexible metering housing is clear so as to provide an indicator to a user when a metered dosage of fluid material is ready for delivery.

11. A fluid dispensing device, comprising:

a collapsible container having an outer surface and a first opening therethrough, the collapsible container defining an interior fluid storage region therein, and an exterior outer region;

a flexible metering housing defined by a flexible button portion and a base portion and having a metering chamber therein with a predetermined volume, disposed in fluid communication with the fluid storage region, an intake valve disposed in the base portion between the collapsible container and the flexible metering housing and permitting unidirectional fluid flow from the interior fluid storage region of the collapsible container into the metering chamber thereby filling the predetermined volume of the metering chamber regardless of the collapsible container's orientation with respect to gravity;

an output valve disposed in the base portion, in fluid communication with the metering housing and permitting unidirectional fluid flow from the metering chamber to the exterior outer region of the collapsible container of a volume of fluid substantially equal to the predetermined volume of the flexible metering housing; and

wherein the collapsible container is made from a flexible material, and wherein the flexible material of the collapsible container and the unidirectional flow of the intake valve cause the collapsible container to collapse as fluid is evacuated from within the collapsible container such that the fluid dispensing device dispenses fluid regardless of the collapsible container's orientation with respect to gravity.

12. The fluid dispensing device of claim **11**, further comprising:

a fluid conduit having a first end and a second end, the fluid conduit connected at the first end to the output valve and at the second end to an exit port defined by the collapsible container.

13. The fluid dispensing device of claim **12**, wherein the fluid conduit is routed through the interior fluid storage region of the collapsible container.

14. The fluid dispensing device of claim **11**, wherein the intake valve and the output valve are one-way check valves.

15. The fluid dispensing device of claim **11** wherein the button portion of said flexible metering housing comprises a flexible membrane, the flexible membrane protruding through the first opening in the outer surface of said collapsible container so as to be exposed to the exterior outer region.

16. The fluid dispensing device of claim **11** wherein said base portion comprises a base plate in which the intake valve and the output valve are formed.

17. The fluid dispensing device of claim 11, further comprising:

at least one standoff connected to the base portion of said metering housing and proximal to the intake valve to prevent the intake valve from being blocked.

18. The fluid dispensing device of claim 17, wherein the standoff is at least one leg.

19. The fluid dispensing device of claim 17, wherein the standoff is a spring.

20. The fluid dispensing device of claim 11, wherein the button portion of said flexible metering housing is clear so as to provide an indicator to a user when a metered dosage of fluid material is ready for delivery.

21. A fluid dispensing device, comprising:

a container having an outer surface and a first opening therethrough, the container defining an interior fluid storage region therein, and an exterior outer region;

a flexible metering housing defined by a flexible membrane, the flexible membrane protruding through the first opening in the outer surface of said container so as to be exposed to the exterior outer region, said flexible metering housing having a metering chamber therein with a predetermined volume, disposed in fluid communication with the fluid storage region, an intake valve disposed between the container and the flexible metering housing and permitting unidirectional fluid flow from the interior fluid storage region of the container into the metering chamber thereby filling the predetermined volume of the metering chamber;

an output valve, in fluid communication with the metering housing and permitting unidirectional fluid flow from the metering chamber to the exterior outer region of the container of a volume of fluid substantially equal to the predetermined volume of the flexible metering housing; and

at least one standoff connected to the metering housing and proximal to the intake valve that prevents the flow of fluid to the intake valve from being blocked;

wherein the container is made from a flexible material, and wherein the flexible material of the container and the unidirectional flow of the intake valve cause the container to collapse as fluid is evacuated from within the container such that the fluid dispensing device is gravity independent.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,387,833 B2
APPLICATION NO. : 12/711853
DATED : March 5, 2013
INVENTOR(S) : LaFlamme et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page

Item (75) Inventor is corrected to read:
-- Roger J. LaFlamme, West Hartford, (CT);
Robert W. Pekar, Florence, (MA);
Jim Warner, Hartford, (CT) --.

Signed and Sealed this
Twenty-first Day of May, 2019

Andrei Iancu
Director of the United States Patent and Trademark Office